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Journal of the Society of Arts.

FRIDAY, DECEMBER 5, 1856.

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HONORARY LOCAL SECRETARY.

The following gentleman has been appointed Honorary Local Secretary for Newcastle-upon-Tyne and its neighbourhood:—

Dr. Thomas Richardson.

THIRD ORDINARY MEETING.

Wednesday, Dec. 3, 1856.

The Third Ordinary Meeting of the One Hundred and Third Session was held on Wednesday, the 3d inst., Henry Blundell, Esq., in the chair.

The following Candidates were balloted for, and duly elected members of the Society:—

Adams, George G.
Anderton, Arthur
Andrews, Charles James
Auckland, John Tattersall
Baines, Edward
Beale, Thomas Frederick
Bell, G. M.
Benson, James William
Brooke, Charles, M.A., F.R.S.
Burrows, R. W.
Challis, Alderman, M.P.
Chrimes, Richard
Clarke, Frederick James
Clarke, Rev. Charles
Cockrell, Rev. G. C.
Cotterell, Thomas
Craske, R.
Cubley, Wm. Harold
Darbishire, Samuel Dukinfield
Darlington, John
Dickens, Alfred Lamerte
Dixon, E. J. J.
Edmondson, George
Farrance, George John
Fandel, Henry
Foster, A. B.
Fry, Henry Laurence
Galton, Capt. Douglas
Godwin, George, F.R.S.
Goodfellow, Thomas
Gordon, Robert
Guest, John
Gundry, Joseph
Gurney, John Henry, M.P.
Hanbury, Daniel
Harrison, J. Fortescue
Heeley, Edmund
Henderson, Thomas W.
Hess, Ralph
Heywood, Sharpe
Hoare, Deane John
Hopkinson, John
Hudson, William
Hunter, John Lawes
Jennings, Richard
Jessop, Sidney
Keats, Frederick
Laird, John
Lawson, John
Leaf, Charles John
Lister, John
Mace, John Ellis
Major, Rev. J. A.
McKie, H.
Mercer, John
Mitchell, Rev. W.
Muir, William
Ohren, Magnus
O'Reilly, Montagu Frederic
Owen, Rev. John Butterworth
Porter, John Thomas Brown
Powis, Major the Hon. Henry Littleton
Pye, George
Radcliff, Joshua
Ratcliff, Charles
Reeves, Charles
Reichenbach, William
Robertson, Andrew
Samuelson, Barnard
Schaeffer, Chevalier Ignatius de
Sim, Alexander
Slight, Frederick
Sommerville, William
Spottiswoode, Wm., F.R.S.
Springfield, Osborn
Staples, John
Stebbing, Rev. Henry, D.D., F.R.S.
Stevenson, George Wilson
Taylor, James
Tuke, James Hack
Vaughan, ———
Wetter, Conrad
Wheatley, E. B.
Wood, Frederick, M.R.C.S.

The following School has been taken into Union since the last announcement:—

Oxford House (Chelsea) School.

The Paper read was:—

ON SOME NEW METHODS OF TREATING LINSEED OIL AND OTHER DRYING OILS, FOR IMPROVING THEIR DRYING PROPERTIES IN THEIR APPLICATION IN PAINTS AND VARNISHES.

By Christopher Binks.

I.—*The Question and the Problem.*

At the time—now some years ago—when the investigations were first entered upon, the results of which are this evening submitted to the consideration of this Society, there was to be found nowhere any accurate history of the peculiar chemical changes the drying oils undergo in the act, on mere exposure to atmospheric air, of passing from a fluid to a solid state; in other words, in the act of drying. Neither was there to be found on record any correct or systematised examination of the reactions to which such oils are subjected when, under the multifarious conditions brought about by their admixture with other materials to form paints and varnishes, they are brought into contact with matters whose presence may be supposed to influence, that is, facilitate, impede, or in some way modify, their drying properties. Much less was there to be discovered any satisfactory or reliable chemical explanations of the *modus operandi* of the various plans and modes of treatment of such oils then and still in use, for giving to them drying properties superior to those pertaining to them in their normal condition.

The oil of the linseed is taken as a type of this class; and, from its vast commercial importance, it is to the treatment of this oil, in order to adapt it to the multifarious uses it is put to, or is required for, were it so adapted, that of all those oils the efforts of the chemist should be chiefly devoted. It will be understood, therefore, that throughout this paper, unless where specially indicated to the contrary, it is linseed oil (its properties and treatment) that is always referred to.

The chemistry of the changes of this oil induced on mere exposure to air, and involved in its solidification, as that chemistry has existed up to this time, may be summed up as being recorded in the stereotyped formula that the oil dries, that is, passes from a fluid to a solid state merely by absorption of oxygen from the atmosphere; therefore, to aid it in its drying, or by some preliminary treatment to facilitate the ultimate result, it was conceived to be necessary only to heat it along with certain metallic oxides, which, previously to its exposure to air, should give it oxygen, and thereby shorten the time needed afterwards for a more complete absorption. Hence the theory, but erroneous one, of the utility of the addition to the heated oil, under the ancient mode of treating it, of litharge or protoxide of lead, and hence, more recently, the super-addition to that of red lead, and subsequently (originating with the French) of the anhydrous peroxide of manganese. The oldest practice was merely to heat or boil the oil. Then followed the conjoint employment of litharge, both of which were purely empirical, founded on no chemical principle whatever. But the more recent ones, of super-adding red lead, or peroxide of manganese, were, as just stated, founded on the principle of giving to the oil, at a high temperature, the proportion of oxygen needed to initiate its drying. Along with these later practices there has, still more recently, crept in the conjoint employment with the lead oxides of the acetate of lead, of sulphate of zinc, and sometimes of the mineral *umber*, this last being used with a view still more completely to impart to the oil the deep brown colour deemed essential to it when transformed into the condition of good "boiled oil."

The principle at the root of all these practices is the old one (so old that its origin must be sought for among the labours of, probably, the Dutch chemists of the last century), of—as it is called—"boiling" the oil, that is, by subjecting it to the action of a very high temperature, to effect its partial decomposition, or a partial or incipient destructive distillation of it, and to aid such decomposition by applying to it one or other, or all, of the materials just referred to, these being selected variously and capriciously, and, as far as the writer has ever been able to discover, without there existing among the operators the most remote notion of the real mode of action. The practice has always been, and still remains, a purely empirical one. This, then, is the practice—that of boiling linseed oil to make it dry—that has so long, and still (with but one or two exceptions, to be hereafter mentioned) universally exists in England. In most large towns or manufacturing localities, as in London, in Hull, in Liverpool, in Leeds, in Newcastle-upon-Tyne, and in Bristol, exists one or more oil-boiling establishments, where in some huge boiler, holding a few pipes or tons, is placed the oil, along with the modicum of litharge and other materials; and a strong heat from a fire, acting externally, is applied till the oil is "boiled;" and this boiled oil constitutes the great bulk of the drying oil, whose innumerable uses and applications meet us at every step and everywhere, and for which, notwithstanding its intrinsic defects, the demand is universal and immense.

The gentleman who this evening presides over this Society, eminent as well for his manufacturing and commercial enterprise as for his scientific acquirements, is himself one of the largest (if not the largest) manufacturer of this oil in the world; but even were these operations conducted everywhere with the same care, and skill, and results that are to be found and are obtained at the works of Messrs. Blundell, Spence, and Co., of Hull, there would still exist, as there now does, an urgent and universal demand, created by the vast advances in art and art manufactures in every other direction, for something better and beyond this—for finer and for a greater variety of drying oils, for better rates of drying, better colour, or greater varieties of colour, and different degrees of limpidity or viscidity, to fit the various tangible but indescribable requirements of the artist and the operator, for better methods of producing them, and for the kind of labour to these ends with which this paper is concerned.

Linseed oil appears in four different forms, from one or other of which the manufacturer, the varnish maker, the painter, and the artist, must, each for himself, select it, according to his special requirements. These kinds are—1st, the oil in its natural state, as it comes from the seed, and called *raw* oil; 2ndly, this raw oil *refined*, or from which has been separated its mucilage and colouring matter; 3rdly, the raw oil *boiled*, that is, made or intended to be made more drying than the original oil; and 4thly, the raw oil put into the variety of conditions as to thickness, colour, and rate of drying that, in comparatively small quantities, is to be found among the varnish makers, the artists' colour dealers, and others.

The oils of the artist class, it may at once be remarked, have generally more the character of curiosities than of utilities, and result from the fondling and nursing of a gallon or two of the oil over many weeks or months, sometimes exposing it to air or sunshine, sometimes treating it with acetate of lead, or with litharge, &c. Each artists' colour-maker has probably his own special mode of treatment, and not unfrequently the artist himself prepares his own oil by some favourite method. The result is generally that such specially prepared oils are by no means remarkable for their drying properties; and the strongest the writer has met with he found to consist chemically of a solution, in any excess of oil, of the oleate of lead, and it had obviously been made by heating raw oil along with litharge and water, and afterwards expelling by heat the *excess* of water used. This kind dried *per se* in 15 hours.

The writer has carefully sought for and examined the kinds of alleged quick-drying linseed oils to be found in the artists' colour-shops in London, and has found them almost invariably to be mere rescripts of the old formula, producing their effects, such as they are, through the medium of the action of the old, or variations of the old, preparations of lead.

The varnish-maker who (when not content with well-settled, *i.e.*, old raw oil long exposed to air and light, nor content with refined or boiled,) would preliminarily treat his own linseed oil to get rid of the mucilage and the colouring matter, sometimes treats the oil, cold or warm, with acetate or protoxides of lead, then sometimes separates all lead by sulphuric acid; sometimes he warms the oil along with sulphate of zinc or some salt of alumina, or applies to it chlorine or some chlorine compound, &c. But the issue of the whole is, that the varnish-maker still requires something better, that is, an oil unchangeable in colour, under the high temperature, needed to dissolve the copal and other gums he has to mix with it, and that after all shall remain a fine drying oil, and as free from colour as possible; this problem, the varnish-maker has not yet solved to his entire satisfaction.

The *refined* oil, in paint-making, is employed chiefly as the vehicle in which to grind the white pigments. The *raw* oil is used to thin and prepare for use the finer kinds of paints, from which *boiled* oil is excluded by its dark colour and after-effects. The raw oil is of itself a very slow drier. The refined is still more imperfect in this respect—and hence, to quicken the work of the operative painter, arises the necessity for using, along with these two, spirits of turpentine or the compositions called driers. Could the raw, or, still better, the refined, be made of themselves to dry with sufficient rapidity, or rather, could a fine drying oil, of an equally fine colour, be obtained, there would then be no need for turpentine as a drier (it would be used to produce certain art effects only) nor for driers nor for boiled oil.

It is necessary to examine in some detail the existing process of boiling, and its results. The oil to be thus "boiled," as it is called, is placed in copper, or boiler plate, or sometimes in cast-iron pans, of greater or lesser capacity, according to the magnitude of the works; and this capacity may be that of one pipe of oil, or of four or six, or eight pipes. On an average, they hold four to five pipes, or about two tons of the oil. Along with the oil is mixed so many pounds of litharge, of red lead, and of sulphate of zinc; sometimes of acetate (sugar) of lead, and umber, or other matters, according to the peculiar notions of the "boiler," so-called, *par excellence*, from the generally long experience such functionary has had in such work, or in the establishment he is attached to. He is generally some old and valued servant, pre-eminent alike for faithfulness to the interests of his employers, and devotedness to the antiquated secrets of his craft. He is the very model of some old, honest, and enthusiastic alchymist, reduced to the inglorious proportions of a modern operative on wages, who roasts linseed oil, that he may unwittingly destroy any valuable property it possesses, but which would remain unaffected, would he only deal with it more gently and tenderly.

To the bottom of the pan, so charged, is applied a fire, and the oil, with its contents, gradually raised to a high temperature. There is first thrown off some water, held combined probably with the mucilage in the oil, and this water forms a yellow-stained froth upon the surface of the gradually heating oil. As the heat increases, there are thrown off, successively, acetic acid, acroleine, and other vapours and gases, that give to this oil-boiling operation its distinctive but disgusting accompaniments, and make it needful that such establishments should be exiled beyond the limits of refined or civilised habitations or existences,—in London, to take refuge in Rotherhithe, on Bow-common, or in the Isle of Dogs; in Hull, in Wincolmlee or at Sculcoates; and in Liverpool or Leeds, in some similar locality and association, where, in close juxta-position with operations on a large scale for manufacturing resin oil, for refining fish oils, distilling coal tar, bone-boiling and grinding, and the preparation of nameless manures, it is hoped that any process of olfactory analysis of the issuing abominations may fail in detecting those that especially belong to this boiling of oil. And even in such exile, the rest they enjoy is but an uneasy one, under the eye of some sanitary official, urged into zeal by some rival interest, or by the real or imaginary spread of chemical knowledge in the community.

It is needless to say here, that on the lands of the highest class of houses, where there is at hand every needful appliance, and is ever exercised a most careful regard for public interests, these boiling arrangements are so made as to minimise and place below nuisance point the exterior evils of such a process; but wherever the oil is so treated, the occurrence to a greater or less extent of these nauseous emanations is inevitable.

Before the heat so applied to the pan has fulfilled its work upon the oil, the temperature of the oil has risen to some 600 or 700 degrees of Fahrenheit. Finally, it has suffered the changes peculiar to its incipient or partial destructive distillation, and passed from the bright yellow colour of the raw oil into a deep and permanent reddish-brown colour; and the more intense this dark colour, the better is the boiling considered to have been accomplished. Upon an average, about ten or twelve hours are occupied, from the first application of the fire, till the oil is in a condition to be still further cooled and transferred to the settling or store vats, whence, after some days, the clear oil is decanted from the sediment (called "foots"), and is in a state to be sent out as boiled oil.

And what is the cost of this operation—of the materials—the fuel and labour used—and what the ultimate value of the clear oil and of these "foots?" What the drying rate and extent of the application of this dark-coloured oil so obtained? And is there no other method of giving to linseed oil the same or more perfect drying and other properties than those realised by an operation so antiquated and impotent?

The clear oil so obtained, even when from the very best makers, always contains a considerable quantity of lead, is dark coloured—almost black, and does not, on exposure to air, materially bleach. It either, under the most favourable conditions, develops, on drying and exposure, a dirty yellow or yellowish brown colour, or it blackens, through reactions between the lead in it and sulphuretted hydrogen. In paint-work, its original dark colour limits its application to coloured paints. From all whites, and the more delicate tints of all interior decorations and artists' work, it either is, or should be, absolutely excluded. Its rate of drying, *per se*, is, on an average of the best kinds, 15 hours; but, more generally, when taken from the smaller makers, or from the shops, this ranges between 24 hours and 60 hours, and, too frequently, it does never properly dry.

But the process is an evidently dangerous one, as the application of a naked fire to vessels containing such inflammable matters must always be, and the fire risk in such establishments is proportional. It is an intolerable and daily increasing nuisance, both from fire risk and from smells; whilst the giving, by this treatment, increased drying powers to the oil is never certain. It ends as often, in some hands, in utterly spoiling the oil as it does in improving it. The gradually increasing importation, stimulated by the late war, into the market of linseed oils obtained, not as of old, from the Baltic, but from East India seed, has introduced into the old process a new element of uncertainty and of probable loss. The difference of climate or of culture gives to the Baltic and to the East India seed oil so different a character, as to require and call for an entirely new mode of chemical treatment, not only in giving it increased drying properties, but in refining and otherwise applying it. This East India seed oil is what is called "tender." It cannot be "boiled," that is, incipiently decomposed by heat, with safety. It, moreover, contains, besides the oil of the linseed, other oils, such as that of the dodder seed, and others not prevalent in the north of Europe, and which are non-drying under the old treatment; and hence has arisen a conviction in the minds of such firms as those of Messrs. Earls and Carter, of Liverpool, where the writer experimented especially upon these oils, that, on the grounds of this change in the character of the oils in the market, as well as upon other grounds, some modification or total change from the old modes, both of refining and of drying, should be sought for. The Messrs. Sissons, Bros., of Hull, not long ago informed the writer that a large batch of linseed oil, containing a large admixture of East India seed oil, which they wanted to boil in the usual manner, had so frothed up and swollen upon the application of the heat, that a large quantity overflowed through an outlet safety-pipe, and was wasted, whilst the remainder was so thick, and otherwise spoilt, as to be unfit to be applied to any ordinary purpose. As these gentlemen remarked, a repetition of such accidents as these, though in their large establishment of no moment, would be of serious importance to the smaller houses.

Involved in these topics is a question of health, now prominently before the public, viz., the lamentable diseases and life-shortenings entailed upon the operatives in lead and the preparations of lead, among which preparations must necessarily be classed the kind of oil we are now speaking of. For a principal element of modern paints, viz., the carbonate of lead (white lead), there is now proposed to be substituted another substratum, viz., oxide of zinc (white zinc), and hence has arisen a contingent necessity, if we thus shall banish preparations of lead from the pigment, to banish lead also from the usual vehicle—the drying linseed oil. The vehicle so used should not, if we would follow up this movement fully, be itself, as it now is, and has always been, because of the lead in the boiled oil, the most immediate agent of those evils thus sought to be avoided. Manganesed oil, that is, the deep red coloured oil, or boiled oil, made by *boiling* linseed oil with peroxide of mhanganese, which I alluded to before, is, both because of its deep staining colour, and of its imperfect drying properties, virtually useless to this end. Oxide of zinc, *per se*, possesses no drying properties whatever; therefore, its mixture with merely raw or refined linseed oil does not result in a drying compound.

All kinds of existing "driers" contain and depend upon lead for their drying powers. How then is this projected substitution of zinc for lead to be aided by any method that, without lead, shall dry the paints so composed, or give to the vehicle the rate of drying that is practically essential. Should it be one of the results of these researches, fully (as it really is, and is submitted to this Society to be) to have solved this problem, the writer conceives that this will not prove to this Society the least interesting part of his labours. He would, however, remark that the perfect innocuousness of oxide of zinc on animal life, has yet to be fully demonstrated; and the gradually increasing development of this branch of manufacture will speedily show this. It is however due, meantime, to say, that whilst the hideous and time-detested evils of lead are indisputable, nothing has yet transpired similarly criminative of zinc.

But a movement of this kind will not be aided by overlaying its evidences. As to the evils alleged to be inflicted on the inhabitants of dwelling-houses that are, or have recently been, painted with lead-compounded paints, worked with lead-impregnated oil (this "boiled" oil), or dried by addition of lead-compounded driers, it is only proper to say, that they (that is, the imputed evils) are not due to the lead in this case. There is no emanation of lead from the freshly-painted walls that can be inhaled, or that otherwise can come in contact with the persons of the inhabitants. It is to the *turpen-*

tine used to thin, and to aid in drying, and which, being highly volatile, and carrying with it (not lead, but) certain products of the decomposition of the oil, that otherwise would go on imperceptibly and innocuously, impregnates the air of the apartments, and is inhaled, that the head-aches, the dyspepsia, and the indefinable sense of disorder, discomfort, and depression, in a newly-painted house, are chiefly due. Here, to the inhabitants merely, there is brought about no actual contact with the lead. Those who actually *handle* the paint are the persons who suffer—the operative painter, and the operative manufacturer of the lead pigments, of the lead-compounded driers, and of the boiled oil.

The scientific vigilance of the French Government takes care to propagate everywhere such knowledge, bearing upon the physical welfare of its people, as chemistry or physiology may bring to its notice; and, among the rest, they encourage in every way the spreading abroad among the operatives a knowledge of the sad evils entailed upon them by handling and working with pigments, paints, and other preparations containing *lead*. And the writer has just been told, by one well conversant with Parisian proceedings of this kind, that the Government will now admit of no contract for public works for paints that contain lead. That, although prohibitively to restrict the use of these is beyond the sphere of an Imperial decree, by proceedings so significant as this of their contracts, they instruct and intimate the importance they attach to the subject.

The oil-boiling trade in England is divided chiefly between two classes:—the paint manufactures and grinders, who boil oil for their own use and for their own sale, and the oil boilers and refiners, who receive from the oil merchants and from consumers—not themselves boilers—the raw oil, put it through the operation, and return it at a certain charge per ton. Those of the former class, generally, in every respect, persons of high character and position, have obviously every motive of interest, had they none other, to do their work well; but those of the latter class (with many most honourable exceptions) have so conducted the business as to reduce it to a most disreputable position. By some of these the oil sent them is sometimes never boiled at all. It is coloured in some way, and returned at a charge of from 30s. to 40s. per ton. In other cases, a hundred weight or two of the genuine raw oil is abstracted, and its place supplied with an equal weight of common resin. In others, the abominable addition is made to it of a quantity of resin oil. If it be known to be for export, and the chances are against any examination before departure, any description of refuse stuff, in no other way saleable or usable, will be mixed with the genuine oil; and in due time, some victim, in one of our remote colonies, finds the paint it has cost him so much money and care to provide never dries; very pleasingly, of course, convincing him of the improving moralities of the mother country. The practical evils of such a system are met with daily and everywhere.

To relieve a wealthy and most important class of persons from this abominable system, by providing them (each for himself, if he wish) with the means of treating their own oil on their own premises, saving both carriage, boiling charge, and the chance of deception, and producing oil of any colour and quality that may be required, is another of the practical results of the researches this paper is intended to submit to the Society.

This, then, is the problem—to take the raw oil, and by some process, free from danger, fulfilling its objects at an ordinary temperature, or, at most, under a steam heat, free from noxious or unpleasant accompaniments, simple, cheap, and expeditious—to give to the raw oil an efficient rate of drying property that can be modified at pleasure; to give to it any colour, ranging between the dark brown of the old boiled and the straw colour of the refined, or a better, if that be possible; to give to it any required degree of limpidity or viscidity that will fit the multifarious requirements of the manufacturer and artist; and to accomplish this at pleasure, with or without the adjunct of preparations of lead, thereby either to meet such requirements as the old habit and style of oils may still perpetuate, or to meet the growing convictions that a more harmless class of paints and paint materials should be adopted.

II.—*Review of Known Resources for Solution.*

For the pure chemistry of the oils and of fatty matters it is needless here to say, that the chemical world was, and is still, indebted chiefly to the researches of Chevreul, undertaken and completed some forty years ago; and that it is singular how completely these researches and their results have both fixed the character of this branch of chemistry, and either precluded or obviated subsequent inquiry. But the labours of Chevreul went to determine their chemical constitution, not to investigate their peculiar changes under all kinds of extraneous action; and the peculiar chemical history of the changes the drying oils undergo under the various conditions here concerned, formed no part of his admirable researches. Both the manufacturing and the chemical world have, in this case, seemed content to accept as a sufficient explanation that of the oxygen absorption, without thinking that this fact might be only one of many actions simultaneously at work, or of a series of complicated changes, each of importance, and requiring to be studied before the subject could be understood, and this understanding be brought to bear upon any processes for improving industrially this branch of manufacture. The more modern organic chemistry, with its accurate manipulations, and the blaze of light it has and will yet throw upon this and kindred subjects of inquiry, has hitherto in its brief career had too many other objects to be devoted to, or so few real workers to undertake them, as to have passed over almost entirely this mere section of so large a field. The result has been that this question of the phenomena involved in the drying of oils had not yet passed through the ordeal of the minute and complete examination modern organic chemistry was capable of effecting, and consequently there had been made no inroad upon either the old theories, or upon the facilities of testing the oils in order to improve their drying properties, that the daily and vast importance of the subject would seem to have merited.

The existing practice, that has been described above, is itself of course older than the comparatively more recent alleged explanation of its chemistry. It is older than the time of Scheele and the epoch of the chemical philosophy of Lavoisier; for oxygen and its reactions, real or supposed, in the case, were not known or recognized for so long a time as litharge and its reactions upon oil have been. But both the practice and its chemical explanaation are sufficiently antiquated to have led to the hope that the application to the phenomena of this branch of industrial chemistry, of the laws and appliances of modern organic chemistry, would surely result (as in so many other instances) in throwing some light upon, or in giving a truer and more satisfactory interpretation of, the chemistry involved in them.

But mere analysis did not furnish the information sought for. The expression, in correct formulæ of the composition of the linseed oil, in its original normal condition, as obtained from the seed, and a similarly accurate expression of its composition, when it had became solidified, threw no light whatever upon changes whose intermediate character, or the character of the series of results intermediate between the normal and final condition of the oil, were probably as important to the end in view as the original and the final conditions themselves were.

Analysis, therefore, would not, and did not, supply the required information, and a totally different line of experimental research was demanded.

But, amidst such a multitude of phenomena, that must surely be presented, if only sought for, among the almost infinite number of mixtures, in daily use, of linseed oil with other substances, are there not already existing, and to be discovered, without the making of special experiments, such reactions, or indications of reactions, as shall give, in the apparently complicated subject, the crucial direction sought for? What kind of paints, with linseed oil as the vehicle, *dry* the soonest of themselves? What kind of substances used as the pigment are thus found to *retard* the drying of the oil? What the chemical actions to be discovered in the peculiar mixtures of materials that the operative painter has, in all times, been using to act as *driers*, each operative, as is well known, having for himself some favourite specific of this kind? What the *modus operandi* of the mixtures, springing originally out of those operative painters' empirical trials, that are now so generally manufactured and sold as *driers?* What is there in these that begets a specific action so singular as the addition to paints of only some very small per-centage of these, results in the paint so treated, drying in from 12 to 18 hours, whilst, without such addition, the same paint may not dry in from 60 to 70 hours? How explain all this—or how can such mixtures be made to develop any chemical facts that may serve to throw light on the subject?

An analytical examination of those mixtures showed that the foundation of the whole was the oxide of lead,—litharge. That in the most potent kinds there was also acetate of lead, mixed variously with sulphate of zinc, sometimes with red lead superadded as the active agents, united with sulphate of baryta, with carbonate of lime, sometimes with caustic lime or with sulphate of lime, as the non-active and bulk-making elements, added in some cases to modify the action of the others, but most frequently to give weight and profit. These, in various proportions and ground up with linseed oil, raw or boiled, in a peculiar order of addition (the peculiar effect of which these researches hereafter explain), constitute the driers of the shops of the present day.

But the result of an examination of those, founded on analysis, developed only the fact of the agency, in some unexplained mode, of the same agents that had always been employed to give such potency as can be given to the drying power of the oil when boiled. It was but the ringing of the changes upon the old materials, and the old method of reasoning; but in the issue of which (that is, in those driers) mere empiricism had, in the usual way of accident, developed better and more active effects. There was still no satisfactory clue to the real cause of the specific action upon the oil of these mixtures, nor, consequently, any light thrown through which to devise better and less objectionable modes, than that of drying paint through the medium of these compounds, or of giving to the oil itself better drying and other essential properties than those obtained by the ancient and most objectionable method of *boiling* it.

III.—*Method Chosen for Solution.*

The course adopted was that of multiplying experiments under conditions so completely comprehended and at command, that the effect of each element of the trial should be apparent at first view. It was the simple plan of bringing into contact with linseed oil every conceivable material, and watching carefully the results, viz., the issues of reactions, as seen or expressed in the one simple result of the oil drying, or being impeded in its drying, under the specific action of each material; to take every material that chemistry can supply, and casting aside for the time all mere theorizing, whether the old doctrine of oxygen absorption, or any other, to rely solely upon the inevitable though slow issue of trial, narrowly watching the results. Surely out of such a course of experimenting, some phenomena will issue that shall give the crucial indications sought for?

To test the drying rate of an oil, or of an oil mixed with some pigment or material to dry it, it is simply necessary to spread it upon the surface of glass, and expose it to the atmosphere, and to note the time occupied in its passing from its fluid to a solid state, or in drying; and the circumstance that on its being touched with the finger, it neither adheres to it on removal, nor resists its removal (that is, not being "tacky"), is taken as evidence of its being dry. It is needless to say that even this simple method involves the necessity for some precautions, always, in one shape or another, due to accurate experimenting. The oils, in comparative trials, must be spread out of a uniform thickness, or the same weights or measures spread over an equal area, and each must be placed in exactly the same conditions as to temperature, exposure to light, and to currents of air, &c. The drying rate of an oil is materially affected by temperature—the hygrometric condition of the atmosphere, by its state as to stillness or motion, and by the presence or absence of sunlight, &c. An oil that in a warm, breezy summer's day will dry in 8 or 10 hours, may not dry in less than 16 or 20 when the air is foggy and motionless; and in an unfavourable winter's day may not dry in less than from 24 to 30 hours. But in all after-reference to drying rates, it will be understood that those stated are obtained under average circumstances, as with the temperature of the air at 60° Fahr., &c. But with regard to these and similar minute details that these experiments have required, however essential and interesting to the experimenter himself, it would be altogether out of place, and beyond the patience of this Society, to do more than thus merely allude to them; but this method of testing, it will be understood, is that adopted and referred to throughout this paper whenever the drying rate *per se* of any oil is mentioned, that is, its rate of drying when tried alone and unmixed with any other substance. When wished to test its drying, not *per se*, as in the case just stated, but under conditions of a more extended exposure to air, brought about by its mixture with some material not itself acting chemically, but mechanically, then this further condition of the test is obtained by grinding the oil up with oxide of zinc for a white, and with lamp black for a black, on glass as before. When so mixed there comes into play other actions and effects, to be hereafter more particularly referred to.

The first series of experiments was occupied with the oil in its normal condition, and with which there was mixed nothing but the material whose specific action or effects (if any) upon its drying properties was to be determined; and this specific action was sought for under two several conditions as to temperature; the first under the ordinary temperature of the atmosphere, (that is, the ordinary conditions that oil in the form of paint or varnish is subjected to) and the second under conditions of the application to the oil, along with the several matters added to it, of higher and various degrees of heat.

The immediate issues of both series of experiments were sufficiently curious and interesting; but it would be trespassing too far upon the indulgence and patience of this audience to recapitulate other than the main results,

Along with 100 parts of the oil were ground up (using a slab and muller of glass) respectively 5, 10, 15, and 20 parts of the substance whose action upon it was to be found out, and these mixtures, spread by a camel's hair pencil upon plates of glass (non-absorbent) and the time of drying of the oil, (or the length of time during which it did not dry, when that negative result followed,) together with any special appearances, and the attendant hygrometric condition and temperature of the atmosphere duly noted.

In this manner were successively applied to the oil such substances as the various oxides and salts of tin, those of antimony, of copper, of arsenic, of zinc, of lead, of cobalt, of nickel, of manganese, of tungsten, and numerous others. There were also applied alumina, lime, soda, potash, magnesia, sulphur, ammonia, and their salts of every variety, and varied in every way by using them (both these and the former) in their dry (*i. e.* anhydrous state) and with their constitutional water and their water of crystallization in every instance on which they assumed or were capable of being placed in these different chemical conditions. In like manner, moreover, was the oil submitted to the action of iodine, of bromine, of chlorine, of cyanogen, of sulphurous acid gas, and the gaseous oxides of nitrogen, and others, and also, of course, to the more readily obtained action of the hydrated acids, the acetic, the sulphuric, the oxalic, the hydrochloric, and the nitric.

Experiments so ordered were multiplied into hundreds; and the first conspicuous results were to reduce to only a mere few the materials that out of all these had any specific action at all of the kind here sought for or desired, viz., a drying action, unaccompanied by any other action that precluded the application of the agent so effecting it to the purpose in view. The result is indeed finally (as will be seen afterwards) to reduce this number practically to two or three, because these peculiar actions, fitted exactly, and better than any others previously employed, all the requirements in drying oil in its various applications; and the next conspicuous result was to show that such of the above substances as did exercise this specific action, were equally effective when either the smaller or the larger proportion was used, that is, the oil dried as well under the action of the 5 parts to the 100, as under the 10, the 15, or the 20 parts, and that, therefore, this action was not of a kind belonging to that class of chemical actions depending upon reactions between elements in equivalent quantities, but of some other and yet undetermined kind.

This series of experiments was followed by another, in which, instead of using the several chemical substances alone, a variety of compounds, mutually reacting with each other, were mixed together along with the oil, and their mutual or contingent reactions upon the oil clearly noted; and it was out of this latter series that there came finally the processes which it is more especially the object of this paper to submit to your attention, and that, in the judgment of the writer, are destined to act in future so important a part, both in improving the processes to be applied, to the treatment of these oils, and because of the extraordinary results in the qualities and varieties of the oils so obtained, in thus extending the sphere of the application of drying oils.

Another long series of experiments, (still conducted on the same general principle of searching, by multiplied trials, and out of the consequent multifarious results, for new or crucial phenomena), had for its object to discover how results obtained under the former series, when the materials whose specific action upon the oil was investigated, *per se*, were modified, when, in addition to the drying compound, or the compound whose drying or contrary action was to be determined, there was mixed with the oil some material intended to bring the mixture into the condition of an ordinary paint, so far as regarded the relative proportion of the oil and of the pigment; and the pigments chosen for this purpose, to mix with the oil, or along with any other experimental material added to it, were as already mentioned, the oxide of zinc and lamp-black, used, of course, separately and comparatively.

To this series was added another, intended to determine the character and amount of action of another kind that the former series had given traces of, viz., the purely mechanical action (not chemical) caused by materials mixed with the oil, mutually reacting among themselves, and, in so reacting, giving birth to a molecular action or disturbance of the oil, and thus causing it continually, during such action, to present fresh surfaces of the oil to the action of the air. An oil so mixed and subjected dries much sooner than one not so agitated or disturbed; and to watch under the microscope, and determine the amount of this action or influence, and the kinds of mixtures that best produce it, constitutes by no means the least interesting of the curious phenomena developed in the course of these experiments.

IV.—*Results and Deductions.*

Confining a brief summary of results to the main object in view, those suggestive of the manufacturing operations to be adopted, and omitting a variety of instructive and curious phenomena thrown out in the course of so much experimenting—such, for example, as the peculiar texture of paints, or surface appearances when dry, produced by unusual mixtures of materials; the various degrees of "gloss," and of "flat," unexpectedly developed, and suggestive of new modes of producing these effects; the curious phenomena of molecular disturbances, already alluded to, when watched under the microscope, and yielding curious art effects, that an artist, provided with sufficient chemistry and his microscope, and who would penetrate into some of the inmost recesses of the chemico-mechanism of his craft, might convert into a study of infinite interest and utility; omitting indications of the pure chemistry of the successive changes in the oil, yet to be thoroughly determined, and expressed in accurate formulæ—omitting these, and many others, the summary of practical results may be given briefly as follows:—

When an oil, or an oil paint, on exposure to air, dries, four distinct kinds of action come into play, to effect, or to contribute to, that result. These are—

Firstly.—The chemical actions taking place naturally (and unaided by any other contingent action) between the oil and the atmosphere, and atmospheric influences, or the *natural* chemical action consequent on exposure.

Secondly.—Those due to some specific chemical action upon the oil of some element in the pigment, or of some element added to it specially to initiate or aid the action that follows upon exposure, or the *induced* chemical action, as contra-distinguished from the natural.

Thirdly.—Those due to the peculiar physical *structure* of the composition of the paint, through which, within the same superficial area, a larger surface of the oil is brought under the action of atmospheric agencies.

Fourthly.—Purely *mechanical* actions, brought about by molecular disturbances in the oil or paint, by which fresh particles of the oil or fresh surfaces of it are being, during the time of exposure, continually thrown up to the action of the atmosphere, by which the atmosphere is admitted interstitially as well as superficially to act upon the oil. These molecular disturbances are caused by the admixture with the paint of some volatile fluid, as turpentine, and its evaporation;—by the escape of water of crystallization of some salt or other added to it; or by chemical re-action and combinations taking place between the elements of the pigment, or between it and some other, or between some other elements added, and resulting in the formation of some new compound, or in some act of crystallisation or other changes of form; and often in the liberation of previously combined water, &c., &c. The materials whose re-actions yield those purely mechanical actions are, of course, such as do not, of themselves, act chemically upon the oil, but act simply by creating in it a movement of its particles during the time of exposure of the paint for the purpose of drying it.

In any instance of an oil or a paint drying, the influences at play to contribute to that result can be traced to one or other, but most frequently to the combined effect of two, or of all of those kinds of actions.

If a given weight of any drying oil be spread in a thin film over a given area—say 100 square inches—it may dry in (say) 20 hours, under the natural chemical action of atmospheric exposure and influences.

If oil of the same kind and weight be ground up to the consistency of an ordinary paint, with some material not acting chemically upon it (as the half-vitrified anhydrous oxide of zinc), and this mixture be spread over the same area, the oil will dry sooner than in the former instance, probably in 18 hours; and this result is due to an increased area of exposure of the same weight of oil, consequent upon interstitial action of the mixture; that is, each particle of oxide of zinc is enveloped in a globule of the oil, and the consistency of the mixture is such that the air finds its way into the mass as well as merely upon its surface, as when the oil is used only *per se*. This is the third kind of action, or that due to *structure*.

Still using the same kind of oil and area of exposure, if a composition be exposed to dry, consisting of three-fourths by weight of the oil, and one-fourth of turpentine plus the oxide of zinc, this will dry in a time considerably shorter than either the first or the last, because the evaporation of the turpentine adds an element of mechanical disturbance, and because that, over the same area of exposure to superficial and interstitial action, there is *less* oil to react with the atmosphere, and its reaction resulting in the drying of it, is concluded in a shorter time, which will probably be about fifteen hours.

If with the oil, plus the oxide of zinc, there be mixed, in equivalent proportions, some acetate of baryta and crystallised sulphate of zinc, the oil in this mixture will dry sooner than that *per se*, and probably about the same time as the last, that is, in fifteen hours; not through any chemical action, for they exercise none upon the oil, but because of the molecular disturbance caused by the combining of the two salts, and the throwing of some portion of the water of crystallisation present.

Again, if with the oil there be ground up, to form the paint, sulphate of baryta, and to that be added some crystallised sulphate of manganese, this, too, will dry somewhat sooner than the oil *per se*, because this salt, being efflorescent, and parting with three of its equivalents of water, throws off those on exposure, although the salt itself (that is, the sulphate of manganese *per se*) has no action whatever upon the oil at common temperatures.

Now, these examples of various actions will sufficiently indicate the kinds referred to under the third and fourth heads; but the most important are the *induced* actions (the second kinds), that is, those which, through some special addition to or treatment of the oil, advance its drying rate both beyond its *natural* and beyond its *mechanically*-produced rates.

Now, the practical results of this long course of experimenting were, first, the discovery of certain materials or forms of materials never previously so used, that exercise specific drying actions upon the oil. Next, to show how very few of all those resorted to experimentally exercise any drying action at all. Then to reduce even these few to two or three, whose properties fully admit of their use for all practical purposes; and finally, to demonstrate what the kind of action really is that thus issues in the solidification of the oil.

It was discovered that the *hydrated protoxides* of certain metals pre-eminently exercise a specific drying action on the oil. That it proceeds in the *cold* with sufficient rapidity to render the aid of heat not necessary, though the application of heat quickens, and is expedient in the operation. The hydrated protoxides of iron, of nickel, of cobalt, and of manganese, are the most remarkable of the class; but it is through the latter (*i.e.*, the *hydrated protoxide of manganese*) that all the singular and happy effects upon the oil are to be practically accomplished.

Linseed oil in its normal condition—*raw* oil—does not dry *per se* under 50 hours. In this, its normal state, it appears (as it may be expressed) to exercise a certain power of resistance against external influences, that would tend to disturb its equilibrium, and transform it from the fluid to the solid state. It yields to these influences only after a few days' struggle, as it were. Now the hydrated protoxides, just mentioned, by mere contact with the oil in very minute proportional quantities, at once break through this state of equilibrium, or power of resistance, and the oil thereupon begins at once to dry; that is, this contact *initiates* the action or series of actions, or removes some obstruction against their exercise, and these then proceed with all the rapidity that unimpeded external or internal influences are capable of. This peculiar action of these hydrated oxides is analogous to, but by no means chemically identical with, that of *fermentation*, that with saccharine matter is *initiated* by addition, in minute quantity, of the fermenting agent, and which then, without further addition, proceeds to completion. The addition to the oil of only from 3 to 5 parts of the hydrated protoxide of manganese to 1,000 of the oil, gives birth to these peculiar changes; and by the simplest of methods of after treatment, this chemical fact is made applicable to the production of any required kind of drying oil.

It is scarcely necessary to remark that this *hydrated protoxide* is, in every respect—in its mode of application, action, and results—different from the old *peroxide*, which at ordinary temperatures exercises no action whatever upon oil. Whilst the latter is used to *give* oxygen to the oil, the property of the former is to *abstract* it. The protoxide is a powerful deoxidising agent; and had the writer been guided by the old theory of *giving* oxygen to the oil, the hydrated protoxide would never have been tried, nor, probably, these curious results obtained. The manganese protoxide is selected out of the others having a similar specific action, because of the peculiar property it alone has, conjointly with its powerful drying action, of *bleaching* the oil finally. The iron oxide gives to the oil a permanent brown stain; the cobalt, a reddish; the nickel, a greenish tinge; and the manganese oxide is readily and cheaply obtained through the medium of the beautiful rose-coloured salt, the crystallised sulphate of manganese.

V.—*Manufacturing Arrangements and Products.*

The arrangements for manufacturing the drying oils on this principle that, under the writer's direction, have been adopted by the well-known firm of Messrs. J. and W. Wilson, of Liverpool, will fully explain the process of manufacture. A large wooden and lead-lined vat, holding several tons of oil, is furnished with a false bottom or compartment, through which steam is passed to warm the oil; and with a contrivance for passing into the oil a large volume of atmospheric air, sent into it by a double-action air-pump, attached (capable of being thrown in or out of action at pleasure) to the main shaft of their grinding mills machinery. The oil, used in very large quantity at a time, is mixed with hydrated protoxide of manganese, or materials yielding that, in quantity ranging between 5 and 14 lbs. to the ton, and the oil warmed up to from 100 to 150 degs. Fah. In a very short time—10 or 20 minutes—the oil loses its peculiar yellow colour, passing through a greenish into a brownish tint, whilst the oxide disappears, being dissolved in the oil. In this state of "solution," as it is called, the oil has already had given to it, by this simple, rapid, and inexpensive operation, a very considerable amount of drying power, and is fit, in this state, to be applied to a multitude of purposes. If, at this stage, the operation be stopped, and the oil left to cool, it will let fall a very small quantity of reddish-brown deposit, the result of a combination between the manganese oxide and the colouring matter of the oil, whilst throughout the oil is diffused an oleate of the oxide of manganese, giving it the brownish tinge. On exposure of this "solution" to air, this tinge, in the first instance, passes into a deep brown, as deep as that of common boiled oil; then there follows a deposit of sesqui-oxide of manganese, and the oil begins to *bleach*, and gradually, as those changes go on, increases in its drying rate. The extent to which the bleaching may finally proceed, may be to produce an oil equal, or better, in colour, than *refined* linseed; or it may terminate in producing a fine amber-coloured oil, these results being influenced by the quantity of the manganese employed. These are the effects of exposure to air after formation of the "solution." With small quantities of oil they will be completed in a few hours; with larger quantities —tons—they require two or three days, when it is only the action of the air upon the *surface* of these quantities that is brought to bear upon the oil. But if the air, by any mechanical means, be forced into the oil in abundance, when slightly warmed, say to 100 degrees Fahrenheit, and thus be brought in contact with every particle of it, these changes are then accomplished with singular rapidity. A few gallons will pass through all those changes, and be finished in from half-an-hour to one hour. A few tons require only from four to six hours to be thus converted into fine-drying, or into bleached, or refined drying oil, requiring only, after this, to be left at rest, for subsidence of the insignificant deposits before-mentioned; or, to have these separated immediately, and the oil is at once fit for use or sale. If, after accomplishment of these changes and the bleaching effects, and separation of all deposits consequent upon them, the oil be further subjected to the action of air by surface exposure, or by the blowing apparatus, it gradually thickens, that is, it passes from its fluid towards its solid form, and can have given to it any degree of viscidity ranging between that of refined linseed and that of honey, in fact, it may, in this manner, be almost solidified,—effects, it is needless to say, of no small value for a variety of purposes.

If, in place of specially and previously preparing the hydrated protoxide, as assumed so far to have been done, one of its salts be taken, preferably the sulphate of manganese, and this be mixed direct with the oil, along with some other compound capable of decomposing the sulphate, and of liberating, whilst in contact with the oil, and under its *nascent* conditions, the hydrated oxide, then there come into play operations and effects of great value and convenience. The agent of decomposition of the sulphate, in this case, may be lime, or magnesia, or ammonia, &c., but the most readily manageable, and which yields the most powerful of the drying oils for all common purposes, is the hydrated protoxide of lead, or the anhydrous protoxide, with water used along with it, or used simply when the manganese sulphate has in it its water of crystallisation. These operations, as will be apparent to any chemist, admit of a great variety of modifications, and of the use of many different materials. For the sulphate may be substituted the chloride—the nitrate or the acetate of manganese, &c.

With the hydrated protoxide of lead and the manganese sulphate as the elements, there is, of course, the formation of sulphate of lead, and this yields a large deposit from the oil at the end of the changes. But the mixture thus obtained is itself one of the best as a drier (for coloured paints, &c.) that can be found.

The final effect of the passing into the oil large volumes of air, after that has been contained for some time, is to increase the weight of the oil. Before it becomes, in this way, too viscid for common use, it is found to have had added to its weight from 2 to 3 per cent. There is, therefore, no loss, but a gain, by this operation. The original cost of materials needed to produce the most powerful oil does not exceed 3s. to 4s. per ton; but every particle of these, as subsequently recovered after the process, is of equal or greater value than the original cost. The cost of a few hours of steam warming the oil, and of attendance, is very trifling; so that the process fully meets all the requirements of the manufacturer on the score of its extreme economy.

The Messrs. Wilson (who, besides being paint and colour manufacturers, are extensive ship and house painters, probably the largest ship painters in England, and requiring, consequently, both large quantities and many varieties of drying oils) conduct these new oil operations on a very large scale, on their new premises in Orford-street, Liverpool, and find themselves delivered from troublesome dealings with oil boilers; produce, with perfect convenience, any quantity they require for their own use, and receive back, in one useful form or another, every particle of oil they subject to these operations.

I cannot close this paper without expressing the obligations these new processes lie under, alike to another gentleman—Mr. Thomas Hubbuck, of London, and to the Messrs. Wilson, for the congenial encouragement given to them during the transition period—that is, during their journey across that debateable ground that always intervenes, in chemical researches and applications, between the laboratory and the manufactory.

DISCUSSION.

Mr. Thos. Wilson, of the firm of Messrs. Wilson, of Liverpool, writes thus:—"I may say I have never had one single complaint of our oil not drying; and I think the best I can say to show that we approve of your method is, that we have put down a new apparatus, more than double the size of the old one, and we now do between four and five tons at a time, and have never had a drop of oil boiled on the old principle since we adopted your plan, now nearly eighteen months ago. We grind the materials together in oil, and add the water when we make each lot. I have now nearly a ton of material ground, so that I do not require to give it much attention, as our man now knows the quantity."

Mr. Varley said, nothing had been stated in the paper with regard to the action of drying oil upon the pigment white-lead, which, properly prepared, he considered was the whitest pigment known. He wished to know how the water was extracted from the oil?

Mr. Laing said, in an experience of thirty years he had found nothing so good as pure linseed oil, and he had adopted the process of throwing in litharge, which carried down the mucilaginous matters containing the water. Practically he found litharge had that effect, and at the same time did not produce any injury to the oil itself.

Mr. Hanhart said he wished to ask Mr. Binks whether he considered that, in the mode of boiling or heating oils by which they acquire drying properties, and are thickened without the addition of any metallic oxide, the change was entirely owing to the absorption of oxygen from the atmosphere, or whether it might not be partially owing to the decomposition of the oil, and the numerous reactions that took place when the temperature was considerably raised? Could the oil rendered drying by Mr. Binks's process be made of the necessary consistence for lithographic purposes? There was a great objection to the use of driers in the manufacture of lithographic varnish, for although it was necessary it should dry when on the impression, yet, owing to the absorbent nature of the leather rollers, they would soon become hard and perfectly useless. Any process that could supply a perfectly colourless varnish from pure linseed oil (or any other oil that had the proper printing qualities) would be a boon to the manufacturer of printing inks, especially for chromo-lithography, where the dark colour that linseed oil acquired when brought to a high temperature was very objectionable, as it spoiled the purity of the delicate tints.

Mr. Thomas Hubbuck remarked that he had seen samples of the oil prepared by Mr. Binks before the process was perfected, and he must say, that the specimens which he saw in the first instance were very crude, as compared with those now in the room. Some of them were dark, and others perfectly white, but there was a varnish smoothness about them all, different from what was usually seen, none of the watery particles being left. He did not know how they evaporated, but such was the case, and the water was completely taken out of the oil.

In the treatment of linseed oil, the opposite of the common process of refining appeared to be required. The usual process was by acids, which were afterwards blown off by steam, and there was always a considerable portion of water remaining, even in the transparent and clear oils. But the oil prepared by Mr. Binks's process was; perfectly anhydrous, no particle of water remaining in it. The drying properties of the oil depended upon the will of the operator. His experiments had not gone to the extent stated by Mr. Binks—that quantity had nothing to do with it; for he (Mr. Hubbuck) had found that the power of the oil to dry was in proportion to the quantity of ingredients he put in. It might be made to dry in six or eight hours, or, if desirable, in half that time. The experiments he had made had never been sufficiently accurate to give him the means of knowing on what that depended, and he had never produced any oil so limpid and crystal as that now exhibited. He had used it with snow white, and his experience did not agree with the opinion expressed that evening, that sulphate of lead was the whitest pigment known, because snow-white (the white oxide of zinc) threw the sulphate of lead into the back-ground in respect of whiteness, and with that he had produced a colour applicable to mastic varnish. Mr. Hubbuck added that he had no doubt as to the value of Mr. Binks's process.

Mr. HEYWOOD said, he had oxidised linseed oil under pressure of oxygen gas of two atmospheres, so as to bring it almost to a solid state, and without the use of the oxide of manganese. If nitrate of baryta were used, the oil would be destroyed, and combustion produced. The oil might also be dried by atmospheric air under pressure. Mr. Heywood stated that oil of turpentine might be oxidised in the same manner as oil by means of air, but never without the pressure of atmospheric air. If Mr. Binks's experiments had been carried on in vessels from which the atmospheric air was excluded, he might think that the air had nothing to do with it; but he considered the process one of oxidation.

Dr. LONGSTAFF said he was sure the Society could not but feel obliged to Mr. Binks for having brought this very interesting subject before them ; especially for having detailed the elaborate series of experiments which he had gone through with a view to arrive at some practical result. He could not, however, but regret the tone of depreciation in which he had spoken of the old and the existing processes. He thought it was to be regretted that in bringing forward matter which he conceived to be important in theory or practice, he should introduce that matter by running down every other theory and every other practice; and he (Dr. Longstaff) felt, as one deeply concerned in this subject,—being connected with one of the largest manufactories of this article,—he felt it due, not only to his own firm, but also to other firms who had long been engaged in the practice of producing boiled oil, to enter his protest against the epithet applied to them and the art they practised. They had been told that the practice was not only unsuccessfully pursued, but that to the present day it was empirical: nay, more, that it was impotent and uncertain. He most distinctly and emphatically contradicted these assertions. He considered that the practice of boiling oil, as it was now carried on, by those most conversant with the subject, was not empirical; that it was founded on a series of experiments conducted with as much care, and with as much scientific knowledge, as those which had been detailed that evening. If he were called upon to define the word empirical, he should say it was a series of experiments without scientific indication as to the results. He should be very sorry to apply any harsh epithet to anything that had been said, but it struck him as most extraordinary that a gentleman should employ the word empirical to any series of experiments which, if entered upon by the most ignorant painter, could hardly be said to be deserving of that epithet; for he was sure that it required but little knowledge of chemical science to tell, *à priori*, what would be the results of three-fourths of the experiments detailed to them that evening. Generally speaking, scientific discoveries were made by a series of experiments directed to a particular end, founded upon some known chemical evidence. They were told that the art which they (the boilers) pursued was also unsuccessful; that they did not produce the article desired. He would appeal to any gentleman conversant with the article to be obtained in this country from respectable oil-boilers, whether it did not answer the purpose desired? Whether, when properly applied to paint properly prepared, it did not dry within a reasonable time? They could not only produce oil, drying within a reasonable time, but that which would dry within a specific time. They could have an oil that would ensure the paint drying within four hours, or within eight hours, and so on, till they could furnish them with a paint that probably would not dry in less than 50 hours. If he could produce them oil that would answer these purposes—however empirical the system by which it was obtained, at any rate it was not unsuccessful. Therefore, he thought that the author of this essay, instead of depreciating the processes already in existence, should have confined himself to bringing before this Society what he conceived to be an improved process. They had also been told that the article as ordinarily produced could not be used for either white paints or white zinc, in consequence of its colour, and was only available for paints of a dark colour. It was, however, remarkable that the contrary of this was the fact—for it was well known to painters that although boiled oil, of a dark colour, when applied to white paint, might, when first laid on, appear to have injured the colour; the paint would, in the course of a day or two, be found whiter than that made with the ordinary oil which had not been boiled. This was owing to the chemical change it had undergone. Much had also been said upon the injurious effects to health of the process of boiling oil as now conducted, and also with regard to its being an intolerable nuisance, and that it could only be carried on in localities where nuisances were tolerated. He was surprised that a gentleman possessing the means of information which the author of this paper had, should have committed himself upon this point. It was well-known that oil could be boiled with ordinary care in almost any locality without affecting the health of the neighbourhood. It was done in situations little dreamt of, and without its being discovered that such a process was going on. Nothing was easier than to pass the noxious vapours from the oil through a fire, thus destroying all cause of the nuisance. It was to be regretted that such statements as these should be publicly made, for, unfortunately, the prejudices of the public were sufficiently strong against manufactories. He did not mean to say that the process might not be so conducted as to be a nuisance; and it was a nuisance, no doubt, if not carried on under proper precautions but it might be conducted in almost any locality so as not to be offensive or injurious. They had heard strong epithets applied as to the unhealthy nature of the process of boiling oil, because it was taken for granted that in boiling oil, lead was used in some form or other; and they had heard a great deal about the injurious effects upon workmen connected with the boiling of oil, the grinding of paints, and other operations in which the use of lead was concerned, but they found no difficulty in getting persons to manipulate not only in boiling oil, but in white lead, and other processes; nor did they find any greater degree of sickness or mortality about persons so engaged than amongst those employed in many other departments of manufacture. All that was required was to use ordinary care in the exercise of those precautions which experience had dictated. Mr. Binks had been unfortunate in dealing in a wholesale, and, he thought, illiberal manner, with the gentlemen engaged in this "injurious" business of boiling oil. They were told that the oil was scarcely to be met with in a pure state, and that all sorts of tricks were played with it by the boilers. Now, really these were hard expressions. He would not undertake to say that circumstances of this kind had not occurred, but he would say they were very rare; and he could name a large number of respectable houses who would scorn to be guilty of any such trick as that which had been imputed. He (Dr. Longstaff) must be allowed to say that he thought these assertions had been made without due consideration and without due knowledge. It was always a disagreeable thing to speak of one's-self, but he felt on this occasion that it was necessary to do so. He had been connected with manipulations upon oils for the last twenty years. Prior to that he was occupied as a public teacher of the important science which had given rise to all the improvements connected with oil and its combinations. He therefore did not bring to bear upon the experiments which he had conducted twenty years ago, and which he had continued more or less up to the present time, a small amount of the necessary theoretic scientific knowledge which he conceived was essential before commencing these experiments. There had been brought before them to-night a number of articles that could be used advantageously in bringing about this desired article, viz., oil that would dry, and that could be manufactured with ease, and without injury to health. He was perfectly acquainted with these articles, and had used them in a variety of ways, before he knew Mr. Binks, or heard of the process which he had submitted that evening to the Society. Neither the articles which were used, nor the process which was described, was new. Mr. Dunn patented, twelve or fourteen years ago, a process for passing through the oil a certain amount of atmospheric air—

A MEMBER—Palm-oil, not linseed.

Dr. LONGSTAFF—It was not likely that any one connected with manipulations upon oil, if he knew it could be done with palm-oil, would not try the same process with other oils. The experiment was tried, not only of blowing air through the oil, but also of blowing the oil through the air, with the same effect. The patentee had not thought of that evasion of his patent. Therefore it would appear that the result of the researches of Mr. Binks that evening was merely to bring together (and he gave him credit for it) a series of facts which were known to individuals before, but which were not published in the shape in which they had now been given. It was well known that every manufacturer—whether he produced an article chemically or mechanically—if he discovered anything which added to the quality, or which lessened the expense of its production, he did not publish it, but was inclined to keep it to himself. That practice he (Dr. Longstaff) had adopted with regard to his discoveries in chemistry—since almost all chemical patents might be easily evaded. He knew of no patent equal to keeping the secret to himself as long as possible, and making the most of it. He was not about to tell them all the experiments he had performed, but he would say that oil had been boiled for a number of years upon principles which he considered quite as scientific as those which had been detailed that evening, and with as satisfactory results, inasmuch as the demand for the article had been large, and it had given universal satisfaction. Mr. Binks had spoken of the hydrated protoxide of manganese, and had said that that was the last article theory would suggest to him, because, instead of yielding oxygen, it was a powerful de-oxidiser. He (Dr. Longstaff) had arrived at the opposite conclusion. Any person acquainted with the manufacture of sulphuric acid, knew the part which nitric oxide played in it. It was a powerful de-oxidiser, and was used to carry the oxygen from one substance and deliver it to another where it was wanted. In a similar manner he would use the ingredient referred to. Mr. Binks said he found there was little difference in the result whether he used five, ten, fifteen, or twenty parts; and, therefore, that the action which took place had nothing to do with the doctrine of chemical equivalents. He (Dr. Longstaff) thought Mr. Binks ought to have ascertained how small a portion it was necessary to use to produce the result, and he thought he would then have found that he could not go beyond a certain point, and would have proved the same law obtaining in this operation as in all other chemical operations, viz., that there is a law of chemical equivalents; and in using these ingredients, a certain quantity was necessary; that if they used less they would fail, and if they used more it would not add to the results. He was sorry that he should have to act the part of the critic; but being connected with this manufacture as now carried on, and believing as he did that such processes were conducted upon as scientific principles as any of the ordinary chemical processes of the day, he thought he should have failed in justice to himself, and in justice to the author of the essay if he allowed the statements he had made to go forth without some explanation, if not without the contradiction which he had ventured to give them.

Mr. ROWNEY (in reference to some specimens of oils exhibited by him) said they were not what was termed boiled oils, but dry oils from oxidation, having been subjected for a given time to atmospheric action, and then filtered, by which means all the properties of drying oils were obtained without chemical additions. If drying oil was required for artists' purposes the drier should be lead, because white lead being used in painting other mineral ingredients would be apt to produce a chemical change.

Mr. HYDE CLARKE wished to ask Mr. Binks a question upon the economical part of the subject, which he had not yet explained. He had understood the author of the paper to state that the ordinary process of boiling was not equally applicable to the new class of linseed oils, or, rather, the adulterated samples which had been received from the East Indies. It was a matter of great importance that they should have a larger supply of those oils, and, therefore, he was desirous of learning from Mr. Binks whether the result of his process was to extend the class of oils which were applicable for the purposes of the arts—whether, as compared with the ordinary process of boiling, he was enabled to make use of a larger class of oils than those now employed?

The CHAIRMAN said, that the author of the paper just read, was entitled to thanks for bringing the results of his researches before the Society. It would be expected of him especially, from the highly complimentary manner in which Mr. Binks had spoken of his firm, to contribute his mite to the discussion. After the manner in which the trade had been attacked, he could not remain silent, and allow such statements to go before the public unanswered. He would confine himself to some practical observations and to the correction of some of the statements put forth in the paper. He was of opinion that Mr. Binks had not done the trade justice. The art of oil boiling and refining had been a very interesting study by himself and his associates for at least forty years, and the processes employed were the result of very numerous experiments, always conducted on chemical principles, on the large scale. He (the Chairman) said that the bulk of the boiled oil produced by his firm was sold with their paints, and used in them, to the extent of 1,500 tons per annum, of the whole amount of oil boiled by them. Notwithstanding this wide-spread consumption, and the many disadvantages under which paint was often applied, it was very rarely that they had a complaint of their oil. Mr. Binks had spoken of boiled linseed oil being excluded from use in white pigments, and that raw oil was substituted on account of the dark colour of the former. This he (the chairman) considered to be a mistake. Boiled oil was invariably used in thinning white lead or white oxide of zinc for use, with such proportion of spirits of turpentine as the intended style of painting might require; and would preserve the delicate white much more perfectly than either raw or refined linseed oil under the same circumstances. Again, the time named by Mr. Binks as necessary for drying boiled oil, was not in accordance with his (the chairman's) experience. It was true that this very much depended on the state of the atmosphere. In practice, during the summer, boiled oil, *per se*, dried in seven to eight hours; on a damp day in ten to twelve hours; in winter from twelve to eighteen hours. Refined linseed oil required, *per se*, 30 hours in summer, and in winter 40 hours. As regarded the danger from fire in boiling linseed oil, that was hardly a question for the consideration of the public. In his own case since 1811, he had but one accident from fire in boiling oil, and that was a trifling one, and was attributable to other causes than the nature of the process itself. On the sanitary view of the question, he could speak with confidence. He had no recollection of sickness at his oil works; and the men, when boiling, had to take their meals close to the coppers, in the midst of the fumes; they were all remarkable for robust health and ruddy faces. He was fully prepared to answer the remarks of Mr. Binks on the "life-shortening" entailed upon the operations in white lead, and the alleged advantage of using zinc white as a substitute; but this subject formed no part of the question of oil-boiling, and ought not to have been introduced by him. The question at issue was not zinc white *versus* white lead, but Mr. Bink's patent boiled oil *versus* the processes now in general use. It was also erroneous to suppose that the small quantity of lead that may be, or is used in boiling linseed oil, could have the slightest effect on any person using it, either in the process of boiling or painting with ordinary pigments, excepting white lead. He thought Mr. Binks had given a very exaggerated statement of the adulterations practised by certain professional oil-boilers and refiners, and that such a system had not been carried to any great extent; at all events, if it had, it was one that would soon effect its own cure. It became a question for the practical man to judge how far the system of Mr. Binks was worthy his notice, as being any improvement on our existing knowledge.

A vote of thanks having been passed,

Mr. BINKS, after returning thanks, said, in reference to Mr. Varley's inquiry, that no free water remained in the oil on completion of the process, the whole was carried away by the atmospheric air in its passage through it. To Mr. Hanhart, who expressed some fears as to the too rapid drying of the oil for lithographic purposes, he said that such fears were needless under this operation, for to the oil could be given, *ad libitum*, any degree of drying power and viscidity. To Mr. Laing, who complained of the effects of sulphuric acid on refined oil, he replied that the materials used in his (Mr. Binks's) process, had the property of removing any acid. To Mr. Heywood, who spoke of the use of pure oxygen to thicken or solidify the oil, and of the action being an oxygenising one, he (Mr. Binks) explained that he admitted the necessity of reactions with oxygen; but that was not all, the phenomena were infinitely more complicated than that alone would imply. To Mr. Hyde Clarke, who wished to know if these new processes applied to other oils, the produce of the colonies, Mr. Binks replied that the reactions with such oils as the sunflower, the castor oil, the poppy-seed oil, and others, were so remarkable, as probably to lead to their economical application to various purposes. From Dr. Longstaff, who appeared as the advocate of vested interests against an innovation, there had fallen nothing whatever, that in the slightest degree affected either the novelty, the success, or the future progress of these plans. The Doctor was angry that he attacked a "class," omitting the conspicuous fact that, whilst in common with a daily growing public feeling of indignation against adulterations of all kinds, and Parliamentary Committees to help it, he (Mr. Binks), in his paper, most carefully and especially indicated the existence of many honourable exceptions. But so far from having overstated these facts, he had, on the contrary, most decidedly understated them, and had nothing to regret or retract from the plain history he had given, and which he well knew would find a welcome response in innumerable quarters. The Doctor's plain declaration this evening of his creed, as to scientific discovery, viz., that the best plan of all was to keep it to himself, and make money of it, was, of course, a revelation that, to this Society, would scarcely be altogether acceptable, for the Society's avowed object was to encourage publicity, and wherever there might be a good—the issue of scientific labour of any kind, to encourage, and to help its being broadcast over the face of the world. The Doctor had taken great offence at his term "empirical," when applied to the ancient and still existing oil-boiling processes, and, in rejoinder, he (Dr. Longstaff) declared his (Mr. Binks) mode of research, in this instance, also to be "empirical." He (Mr. Binks) was only too happy to accept the charge. "Empirical" had, as was well known, two meanings or significations—the one was a popular expression of contempt—the other a proper expression or description of a certain line of philosophical procedure. He (Mr. Binks) had most carefully described the line of procedure or of experimenting. He adopted it in this case, and he knew of no better word by which to describe it than "empirical." But, contrary to the "Empiricism" of the old oil boilers, it had ended in a discovery (its object and intention), whilst the empiricism of the oil boilers had only ended in Dr. Longstaff's remaining the advocate of a system about four times as old as himself. The doctor intimated, in pretty plain language, that he had always known of those peculiar reactions which he (Mr. Binks) called his own; and he gave, by way of proof, instances of the passing through oil of atmospheric air as long as fifteen years ago. Now, every one knew how common it was to employ atmospheric air to bleach oils; and, no doubt, many instances had occurred (as in the case of Mr. Blundell) in which linseed oil had been so treated. But in no instance whatever had it ever before been done in the conjoined manner in which he (Mr. Binks) employed it and to which conjoint action alone its valuable effects were due. It was needless here to remind the Society of the fact that, no sooner did an invention or discovery arrive at success than there started up immediately a host of claimants who assumed the position of "prior users." The perfect novelty of his (Mr. Binks's) discovery, had hitherto been acknowledged everywhere—both among the English, the French, and other foreign chemists—even among the Americans, and for the first time (by Dr. Longstaff that evening) had its novelty been disputed, though the doctor did not venture to allege that either he or any one else was ever previously aware of the peculiar action of the hydrated protoxides upon which it was founded, conjointly with the after-use and adjustment of atmospheric air. Dr. Longstaff had touched upon some points of the abstract chemistry of these operations in a manner that certainly excited in his (Mr. Binks's) mind the utmost surprise—coming, as it had from an "ex-teacher" of the science. He (Dr. Longstaff) disputed the deoxidizing action of hydrated protoxide of manganese, and alleged that this oxide would *give* oxygen, not *abstract* it; that it was capable, according to his notion, of playing a similar part to that played in sulphuric acid-making by "nitric oxide"—that is, it would either take oxygen or give oxygen, according to the other element or elements in contact. Now, the hydrated protoxide of manganese is so powerful an absorbent of oxygen, that it requires the utmost care of the chemist, either to obtain or preserve it without passing into a higher state of oxydation. It passes instantly, on mere exposure to air, into the sesquioxide, and in no instance whatever, throughout the whole range of chemical actions, can be given of its *imparting* oxygen to another element. Between the two sets of actions—those of this hydrated protoxide upon oil, and those with the oxides of nitrogen in sulphuric acid-making—there exists not the most remote analogy. The doctor's reasoning and his illustrations are, both of them, equally and most singularly at fault. The doctor also utterly mistakes his (Mr. Binks's) explanation respecting the peculiar action exercised upon the oils. Mr. Binks distinctly stated, that the hydrated protoxide unites both with the colouring matter of the oil and with its oleic acid, forming a reddish matter with the former, and an oleate of the oxide of manganese with the latter. Mr. Binks did not need to be reminded by Dr. Longstaff that both these actions must be accomplished under the operation of the inevitable law of combination in equivalents. What Mr. Binks had distinctly stated and meant, and obviously so, in his description of the oil's ultimate solidification, was that these actions *initiated* those changes, but did not issue through the transformation of the whole of the oleic acid of the oil, into an oleate of manganese.

The Secretary announced that Messrs. Wilson, of Liverpool, had promised to deposit at the Society's House, for inspection of the members, a series of samples of oils prepared by Mr. Binks' process.

The Secretary further announced that on Wednesday, the 10th instant, a paper, by Mr. W. Fothergill Cooke, would be read, "On the Utilisation of the Sewage of Towns by the Deodorising Process established at Leicester, and the Economical Application of it to the Metropolis." On this evening Dr. Lyon Playfair, C.B., F.R.S., will preside.

EXAMINATIONS PRIZE FUND.

The following additions have been made to the Prize Fund :—

J. W. Gilbart, F.R.S.	£10 10 0
Chas. Wye Williams	10 10 0
Thomas Martin	5 0 0

EXPERIMENTS WITH SNAKE ROOT.*

Some experiments were made at the Society's House, on Friday last, with the view of testing the efficacy, as an antidote to the bite of venomous snakes, of a root recently brought to this country by Mr. Temple, Chief Justice of Honduras, and which, if not the veritable guaco so famed among the Indian tribes for its medicinal properties, resembles it closely in appearance, belonging to the same class of serpentaria, and which is universally reputed throughout Central America to possess similar virtues. Whether the powers ascribed to this herb by the snake-charmers and natives of Central America were real or imaginary, and whether the efficacy of the plant was universal, or limited to the bites of the reptiles indigenous to that part of the world, were problems which yet remained to be solved, and which assuredly deserved the attention of pathologists. Unfortunately, the experiments were not so successful as might have been anticipated. It was determined to test the potency of the plant, and for this purpose some eight or nine drachms of the infusion were given by Dr. Chambers to a healthy rabbit, which was then put into the same box with two puff-adders of the deadliest reputation, procured from the Zoological-gardens. For more than ten minutes the snakes endured the presence of the intruder, but at length they flew fiercely at him, and one of them bit him in the mouth. On being taken from the cage the same infusion was again administered, and the wound was fomented; but the hind legs became rapidly paralysed, tetanic convulsions supervened, and the animal languished and died in thirty-five minutes from the time it was bitten. Owing to the contraction of the jaws but little of the second dose of the infusion reached the stomach of the rabbit, and Mr. Temple was of opinion that the tincture would have afforded a fairer test, inasmuch as it had been prepared from the herb in a comparatively fresh state, whereas the infusion was made from the dry root, which may possibly be of inferior strength.

The following letter has been received from Mr. Temple :—

SIR,—I have received the following most interesting letter from Dr. Chambers, relating to the late experiment which was made at the Society of Arts for the purpose of testing the reputed virtue of the snake-root in curing snake-bites. With the doctor's permission I forward it to you for publication :—

1, Hill-street, Berkeley-square, Nov. 29, 1856.

MY DEAR SIR,—I must not delay to thank you for the opportunity of seeing your experiments on the effect of snake poison yesterday. Though unsuccessful in proof of the antidote possessing any preservative power, I think what we saw was not without instruction. From what I heard and saw, I became satisfied that a repetition of such experiments must always be inconclusive, *whether successful or not*—that is to say, whether the rabbit to which the antidote was given recovered or not. Suppose

(First.) That the rabbit dies; then a fallacy may exist—

(A.) In the possibility of the antidote being itself a poison to the animal—

(B.) In the small size of the animal selected not giving sufficient natural reaction—

(C.) In its powers of vomiting up the nauseous drug.

(Secondly.) Suppose, on the other hand, that after taking the antidote, and being bitten, the rabbit recovers, or does not suffer; then a fallacy may exist—

(D.) In the fact that animals *bitten* are not always *wounded*. We ourselves saw the second rabbit bitten in the back, where the fur is thick, and not hurt. And pigs never suffer from snake bites, because of their dense skin—

(E.) In the fact stated by the keeper, that an animal, even if wounded so as to absorb some of the poison, does not always die. The symptoms may commence and not prove fatal. This must be still more frequently the case in the larger animals than in the smaller, because of their greater powers of resistance; and probably depends on the quantity of poison injected.

Fallacy A might be counteracted by trying the effect of the antidote alone; Fallacies B and C by experimenting on horses, which are as large as men, and cannot vomit what they are drenched with. A knacker's yard would afford ample facilities. Fallacy D cannot be avoided in using living snakes; the best way would be to get imported a sufficient store of snake-fangs to impregnate a lancet at will, and wound the animal at one's leisure. Mr. Waterton says that the Macoushi Indians of Demerara always have a store of the poison from the Labarri and Counacouchi snakes, to be used in the preparation of Wourara. (See "Waterton's Wanderings: First Journey," p. 55.) It might be preserved either by using the precautions employed for keeping vaccine virus, or by mixing it with vegetable matter (as is done in preparing the Wourara, of which the main activity lies, doubtless, in the snake venom). The greater command we should have over the experiment would much reduce Fallacy E.

All this will take time, and money, and trouble, but anything short of it can only lead to fallacy. You see the question we ask Nature is this: "Do the recoveries after the snake-bites arise from the employment of antidote, or from uncertain operation of the venom?" The question, so far, has purely a scientific interest, not a practical one; for I understood you to say, that the plant grows universally, and is universally used as an antidote—so that our belief will not extend the belief of the parties mainly concerned. But some truly practical questions might be solved by the opportunity of trying experiments more accurately. First, "Will artificial respiration, carried on for a sufficient period, restore a bitten animal in the same way as it will one wounded by Wourara?" (I refer to Lord Derby's donkey, experimented on by Mr. Waterton.) Secondly, "Is a person once bitten equally liable to be again infected, or is the snake poison like that of small-pox, vaccinia, scarlatina, &c., incapable of acting twice in the same individual?" This inquiry is suggested to me by the fact that persons much bitten by fleas, bugs, lice, and I believe by bees, do not suffer the same amount of inflammation as we do. A flea-bite in the denizen of a low lodging-house is simply a little puncture, barely visible, without any halo of redness. If such is the fact, inoculation with the venom of some of the milder snakes might preserve against the more deadly, as vaccine virus preserves against small-pox; or snake-venom might be a preservative against hydrophobia. Again, "Is the venom of different animals of a different nature, or is it merely the degree of concentration or the quantity injected which makes the effects various?" What leads to this suspicion is, that the local effects of wasp or hornet stings on the neighbouring nerves (viz. numbness and paralysis) and the erysipilatous inflammation they cause is identical with the more extensive results of snake-bites. If the suspicion were true, we should have in our own wasps and hornets a diffused agent, which might be concentrated into a most powerful one by artificial preparation.

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* See *Journal of the Society of Arts*, Vol. III., page 161.

Numerous other questions, whose solution would benefit humanity, or at least give us that power which springs from knowledge, might arise in the course of a series of experiments on deadly venoms such as I suggest.

The failure of plants of this sort to prevent the effects of snake poison on animals, is further confirmed by some experiments made (on rabbits, bitten by the whip snake) by Mr. Cæsar Hawkins, in 1830. These rabbits were thoroughly dosed and rubbed over with guaco, yet they died. just as yours did: nor did the reputed antidote seem to have the slightest effect on the symptoms, nor to have any influence in repelling the snake from the animal. The guaco was also tried in five cases of hydrophobia, without any effect on the symptoms, or at least with an effect very inferior to the palliation which hydrocyanic acid affords. Two of these cases were in dogs, and three in the human subject. (See *London Medical Gazette*, Vol. VI., p. 507; Vol. VII., p. 594; and Vol. VIII., p. 237.) So that, the "true guaco" seems as little to be trusted as "false guaco," if, indeed, they are not the same plant.

The doubts thus thrown on the efficacy of reputed antidotes should lead us to look in other directions for protection of the lives of our countrymen, whom it may be necessary to send out in large gangs, to clear the forests of the Isthmus for an inter-oceanic railway or canal. And I think, even the short opportunity we had of observation on Friday may teach us something towards it.

1st. *The snake could not bite through the skin of the rabbit's back.* Stout boots, hedgers' gloves, and leather breeches, would, therefore, be a complete guard to the parts covered by them. A short fang would not penetrate even a woollen jersey.

2nd. *It often took a bad shot at the part intended to be wounded.* If the snake is seen first, I am sure a moderately active man may keep it from biting his face, and destroy it with the well-known weapon, a carter's whip.

3rd. *The snake would not bite, so long as he was warm and comfortable.* When he had his blanket, or the rabbit's fur, to lie against, he was quite placid. Flannel bags, then, would be most efficient traps. The principle of making a comfortable place for a trap is that of the wicker-work bug-traps.

It would not be necessary that the whole population should be equally protected. One or two patrols, with a few pigs, trained, as they easily may be, to obey the voice, could clear the diggings of snakes every morning. The sleeping camp might be guarded with wire net, or perhaps by a ditch, filled with the broken bottles which always accumulate in an Anglo-Saxon encampment.

Any man who moves timber, or anything likely to be a hiding-place, without gloves on, should be fined, and a reward given for snakes' heads.

I feel sure, that further observation of the serpents' habits, would lead to such further means of safety, that fear would be ridiculous. At present, the danger arising from snakes concealed on branches of trees level with the face, seems a formidable one, and suggestions on this point would be valuable.

If many Englishmen go out as navvies to South America, I expect that the proportion of deaths from snake bites, to that of deaths from jungle fever, will be as 1 to 10,000. That invisible winged dragon is much more formidable than any creeping monster.

Believe me, my dear Sir,
Yours faithfully,
THOS. K. CHAMBERS.

R. Temple, Esq., &c., &c.

I quite agree with Dr. Chambers in thinking that the experiment which we tried the other day was inconclusive, and that even several experiments might be so; but it must be admitted that it is by experiments alone that we can arrive at facts. We are desirous of ascertaining whether there is any ground for the supposition, so generally entertained, that the snake-root is a remedy for snake-bites. We can only do that by making experiments upon animals which have been subjected to the envenomed tooth of those reptiles, and the means within our reach are extremely limited. It will not be denied that such experiments should be confined to animals in a healthy state; for, if tried upon condemned cattle, either on account of disease, or old age, it would be impossible to say, if the creature died, whether death was the result of the disorder, or of the poison. We are then compelled to have recourse to rabbits, Guinea pigs, dogs, cats, "rats and mice and such small deer," in order to try the efficacy of the real, or imaginary remedy. It would be a hopeless request to ask for a fine healthy racehorse, or hunter, or even a respectable cob, from Tattersall's; and I fear that our country friends would have a strong objection to "linding us the loan" of their milch cows and pigs. It might, however, be a matter for consideration whether a few ticket-of-leave men, and others of that genus, might not in this way be made subservient to science and the welfare of man. I merely suggest this as a hint, which, as parliament will ere long reassemble, I have no doubt will be acted upon.

Dr. Chambers is of opinion that the experiments must be inconclusive, whether they be successful or not. First, if the rabbit dies, there may be a fallacy. (A.) "In the possibility of the antidote being itself a poison to the animal." It is very difficult to say what is, and what is not, a poison. Almost every plant may be said to be poisonous, if a sufficient quantity be taken. In this sense, probably, a strong dose of the tincture of the snake-root might be poisonous to the rabbit, inasmuch as it is a powerful stimulant. In the ordinary acceptation of the term, I do not think that the herb would be poisonous to a rabbit, or any other animal. It grows wild in the woods, and every animal, large and small, has ready access to it. I have heard it stated by intelligent and observant men, who had long been companions of nature in her wildest forms, that if the snake-root, or guaco were very abundant in any place, that circumstance amounted to a notice of "beware of the snakes;" for most assuredly in that favoured spot those ancient enemies of the human race, like the merchants on the Rialto, "most did congregate." If this be true—and I must admit that it sounds very romantic—it would seem that nature, whilst she sent the poison, beneficently placed the antidote near at hand. There are certain birds in Central America which feed upon snakes and lizards, without being at all particular whether they are poisonous or not. These birds are frequently observed to partake of the leaves and bark of the guaco. Does the instinct of these animals—a quality in the inferior orders of the creation so much superior for self-preservation, to human reason—direct them to *this* plant as a remedy for the poison of the snakes which they may swallow? It is not a violent presumption.

(B). "In the small size of the animal selected not giving sufficient natural reaction." That is unquestionably a difficulty which we have to contend against. But although, from that circumstance, a failure in producing a cure would not be a fact conclusive against the supposed remedy, *one* successful experiment would be very powerful evidence in its favour.

"(C.) In its powers of vomiting up the nauseous drug." If the stomach of the animal *did* reject the tincture, or infusion, that fact would, of course, be observed, and the dose might be repeated. In the case of the rabbit on which we experimented a few days ago, I certainly thought that the fluid which proceeded from it, after it was put into the snake's den, came from the stomach, and that it was the infusion which had been previously administered to it. After the rabbit had been bitten, very little, if any, of the infusion which was given to it went, down its throat. Dr. Chambers thinks, on the other hand, that, supposing ‘after taking the antidote and being bitten, the rabbit recovers, or does not suffer, that a fallacy may exist." This is, no doubt, true; but still, I think, the question would be decided by a number of experiments. If the skin of an animal like that of the pig, or the rhinoceros, or the armadillo, is so thick that the tooth of a snake would not penetrate to the blood-vessels, there is no question that a bite would be harmless, for the poison, to take effect, must come in contact with the blood. In such a case, therefore, if the tincture were administered, the non-dying of the animal would be productive of a fallacy, if it led to the belief that its life had been preserved by the drug. Again, it is not difficult to believe that the most poisonous snake may not at all times be able to inflict a deadly wound. But this may be accounted for. It is an ascertained fact that the poison of the snake is deposited in a small sac, which is placed at the root of a moveable fang situated in the upper jaw, immediately under the eye. This fang is hollow, and when it is pressed down upon the sac the poison is ejected from the point. If a snake, under excessive irritation, has bitten anything savagely, it is not unreasonable to suppose that it may have parted with the whole of its valuable stock on hand, and that time may be required to produce that peculiar combination of animal juices which constitutes the poison, and to re-supply the reservoir with the fatal fluid. If, then, a snake were to bite any animal before its malevolent mechanism had produced a fresh supply for the market, it is probable that the injury inflicted would not be more serious than an ordinary wound. In trying an experiment with a venomous snake, care should therefore be taken that it should not bite anything for a considerable time previously. What are the constituent parts of snake poison? In this scientific age, when analytical chemists so very much agree as to the nature and effect of all poisons, especially those which, like that of the snake, produce "*convulsions with tetanic complications*," why does not some person analyse this deadly product of the animal world, for the purpose of discovering a decisive antidote? Dr. Chambers asks whether a person once bitten is liable to be again infected, which inquiry is suggested by the fact that persons much bitten by fleas, &c., suffer less inflammation than those who are not inured to it. My experience in such matters does not enable me to support that theory. I have had much practical knowledge of bites of all kinds—mosquitoes, sand-flies, doctor flies, centipedes, cockroaches—and I must confess that I never could get used to them. It is a singular thing that the negroes, who are said to have an additional cuticle, and whose bodies are constantly exposed to every species of attack, feel much more acutely than Europeans the bites of mosquitoes and sand-flies. I have witnessed 100 or 150 black soldiers at parade on a calm, hot, cloudy morning, when the mosquitoes and the sand-flies have vied with each other in tormenting sinful man. Nothing could be more grotesque and ridiculous than the actions of those sooty warriors. First they would clap the backs of their hands, then slap their faces, and then, at the moment they were commanded to present and make ready, drop their muskets on the ground, and tear the flesh off their calves and ancles. I do not think that human nature can get reconciled to bites. As to the effect produced upon different persons, that, no doubt, will much depend upon the state of the blood and the general condition of the body. I knew a person who, being bitten by a snake, died within an hour—he was a confirmed drunkard. In a healthy person the venom would be much slower in its operation. Very much also will depend upon the part which is bitten. A wound inflicted on the ancle, or the calf of the leg, will not be so rapid in its effects as one on the thigh, or the throat. Dr. Chambers advises persons who are called by their duties to be much in places which are infested by snakes to wear thick, high boots, and hedgers' gloves. This would, undoubtedly, be a very wise precaution. But a thick leather boot will not always protect a person from the bite of a snake. A very singular example of this was related to me. A man wearing a pair of stout boots, which came up to the knees, shouldered his axe one fine morning, and proceeded to the forest to cut wood. After he had aimed a few strokes, a snake, not approving of his proceedings, bit him in the calf of the leg. Our woodman, however, thinking that his boot had sufficiently protected him, laughed at the snake, and went on with his work. But after a little time a feeling of sickness and stupor came over him, and he thought it advisable to wend his way home, which he did, and died in about an hour after he had got there. The boots—they were capital boots—were sold. The fortunate possessor, as he thought himself, carried them home, and then put them on to see if they would fit. In a few hours he was a corpse. This was considered very strange—some thought it was apoplexy, some paralysis, and some thought it was an affection of the heart—but nobody thought of suspecting the boots. In a short time they again had an owner. It will scarcely be credited —but it is a fact—this man died also. At length the boots were examined—what caused the investigation I do not know, but I suppose the fell Atropos thought she had done enough mischief with a pair of boots—and in one of them was found sticking the tooth of a snake, in such a manner that in drawing on the boot the leg must inevitably be scratched by it. But mosquitoes even will bite through a boot, unless it be very thick indeed. There is a species of mosquito called the striker —a large, greyish, villainous-looking monster—against which scarcely any clothing is a protection.

Dr. Chambers is doubtful whether the "true guaco" and the "false guaco"—the plant with which we experimented, are different plants. They are certainly very different indeed, although the one which we used would be called guaco by most of the natives in Central America. I shall give you a very particular account of the real guaco in a short time, and state a number of cases to prove its title to be considered a remedy for snake bites. In the meantime, I think it will be very desirable to try some more experiments with the "snake root," and, if we arrive at the conclusion that it is worthless, to cause that fact to be disseminated as widely as possibly in Honduras and Central America, in order that no unfortunate recipient of snake venom may lose valuable time by indulging in delusive hopes that it will prolong his existence.

There is much food for thought in the interesting letter of Dr. Chambers; and the observations which I have made are not intended to express any difference of opinion from him, but to promote discussion upon a matter of paramount importance to all those whose destiny leads them to pass much of their time amongst the jungles of India, or the dense forests of Central America. I am, &c.

R. TEMPLE.

December 2, 1856.

Proceedings of Institutions.

Huddersfield.—The annual distribution of prizes in connection with this Institution took place at the Philosophical Hall, on Wednesday evening, the 26th ult., under the presidency of Lord Goderich. Prizes were given by his Royal Highness Prince Albert, by Lord Goderich, by H. Tindal Atkinson, and other gentlemen. Amongst the gentlemen present were, Viscount Goderich, M.P., the Right Hon. Sir John Pakington, Bart, M.P., the Rev. Dr. Booth, F.R.S., from the Society of Arts, Edward Baines, Esq., president of the Yorkshire Union, John Hope Shaw, Esq., president of the Leeds Philosophical Society, Edmund Eastwood, Esq., president of the Huddersfield Mechanics' Institution, &c. Mr. F. Curzon, the secretary, read the report. The distribution of prizes then took place; after which the meeting was addressed by Lord Goderich, who said he was sure the many gentlemen of eminence and distinction present could not have contemplated the scene before them without a feeling of hope for the future of a district that could bring together between 700 and 800 students such as those before them, and which could show some who had displayed considerable attainments. The distinguishing feature of the Huddersfield Institute was its classes. They heard in these days, and heard most truly, of the worthlessness of testimonials; but those members of this Institution who had just received prizes had received a testimonial which could not be disputed; and he could not doubt that those in this district who had to engage the services of such persons would be inclined to give great weight and effect to a candidate for employment who was the holder of one of these prizes. On a recent occasion, when the Society of Arts established their examinations, they sent circulars to the large employers of labour throughout the country, asking whether they would be ready to give weight to the certificates that might be awarded by the Society, and they received to that invitation a most complete response. Now, what was done by them on a large scale throughout the country would, he was convinced, be done on a smaller scale within that district. Most of them were aware that in the course of next year it was the intention of the Society of Arts to hold in that town their annual examination of the members of Mechanics' Institutions in the North of England, for the purpose of awarding their valuable certificates. They would then have to compete with other students from the Mechanics' Institutes of Yorkshire and Lancashire, and to maintain not only their own position, but that of their Mechanics Institution, to show to the Society of Arts they had been right in selecting Huddersfield as the place at which their examination was to be held. The gentlemen who had consented to act as examiners to the Society of Arts were men of the greatest distinction and ability in the various branches of knowledge to which they had devoted themselves. His lordship concluded by speaking of the debt of gratitude they owed to those who had acted as voluntary teachers. The Huddersfield Mechanics' Institution was engaged in the great work of popular education; and when they saw such zeal, such attention, and such results, he, for one, felt it impossible to despair, that in "a good time coming," that work would be accomplished; and that the highest aspirations and hopes of those who had permitted themselves to look foward hopefully to the future would not be disappointed, so long as men were found to study in the spirit which marked the students of that Institution, and to teach in that yet nobler spirit which actuated its teachers. The Rev. Dr. Booth proposed the first resolution, which was in favour of the introduction of the principle of education into the system of instruction at Mechanics' Institutions. He had so recently, and on more than one occasion, placed before the public his views on educational matters, that he would detain them only by a very few brief observations. That the education question was the most important social problem which awaits solution, did not admit of a doubt. It lay at the very root of every social reform. The great point of discussion at the present time was this, whether education should be promoted by efforts which are purely spontaneous and voluntary, and therefore uncertain, or whether the whole country should be called on to make an united effort to establish a national system. Somehow it was taken for granted that, having levied a rate, and nominated the managing committee, and built the schoolhouse, and provided apparatus, and engaged the master, all which can possibly be required is accomplished, and the education of the children of the neighbourhood was thus secured. But what if the children would not come to the school, or would leave it again before they had acquired a smattering of the rudiments of the commonest elementary knowledge; how was this state of things to be provided against? This was no far-fetched anticipation or doubtful apprehension. It was realised in all the yearly reports of her Majesty's Inspectors of Schools. It was the universal complaint that the children of the poor left school earlier every succeeding year. That as the quality of the education is improved, the time given to school by the children is shortened, so that the final result is a deterioration rather than an improvement. They might depend upon it, they would not sensibly raise the standard of education until they created a demand for it. Let the Government of the country make intelligence and industry the passports to employment, not private interest or family influence. Let the great public companies, the great employers of labour, look only to the fitness of the candidates for employment, and then they would see a very different state of things. Whether they would have a state system of education, or a voluntary scheme, was a matter of very insignificant importance, compared with this,—whether the country at large, not merely the Government, but the other great employers of labour as well, shall insist upon education as a necessary passport to every but the lowest and least remunerative employment. The schools they had at present were only half-filled. But if by any means they could make instruction a necessary, somewhat like meat, drink, or clothing, people would endeavour to procure it. Education, though essential, was not a pressing want, and like religion, but too many were contented to live without it. They should create a demand for education, and the supply was sure to follow. Let them promote only those who are well instructed, or who have instructed themselves, and a supply of the right men for the right places would not fail them. John Hope Shaw, Esq., seconded the motion. The next resolution, which spoke of the advantages of classes, was proposed by Sir John Pakington, who said he rejoiced in the practical proof of their success which had been shown that evening. He considered the Yorkshire Union of Mechanics' Institutes an honour to the country, and he was glad of the opportunity of expressing his high respect for Mr. Baines, the President of that Union. W. Willans, Esq., seconded the motion, and said he should be happy to contribute a prize next year. The next resolution was proposed by Edward Baines, Esq., and was to the effect "That the measure proposed by the Society of Arts to hold annual examinations of students of Mechanics' and similar Institutions, and to give prizes and certificates for proficiency, which has received the approval of a large number of employers throughout the kingdom by the declaration of these that they will attach respect to such certificates, is an important and valuable means of extending and improving the education of the people, as it will constitute an efficient practical stimulus to study on the part of members of these Institutions." He (Mr. Baines) could remember when there was no Mechanics' Institute in Huddersfield. They then met in small numbers in the ill-lighted Lancasterian school; and at that time it was impossible for him to look forward to such a scene as had been witnessed that evening. The speaker next adverted to the forthcoming examination of the Society of Arts in June next. He looked upon the proceedings of the present evening as a rehearsal of those that would take place next year; and he advised the members still to work on, as on that occasion they would have Leeds, Bradford, Sheffield, and Manchester, as well as others from Yorkshire and Lancashire to compete with. With reference to the prize fund, at least there would be £500 to distribute in prizes; but in Yorkshire they ought to do more than this; and he sincerely hoped the gentry would send in subscriptions, and show that they felt an interest in the education of the people. Where such a state of things existed, there must be a greater amount of moral excellence, and they would thereby raise the whole moral status of society. The resolution was seconded by James Hanson, Esq. John Brooke, Esq., moved a vote of thanks to the donors of prizes, which was seconded by Emanuel Eastwood, Esq., president of the Institution. A similar vote was proposed to the examiners by Joseph Rothery, Esq., and was seconded by Mr. Marriott. A vote of thanks to the chairman was proposed and seconded by Joseph Batley, Esq., and Dr. Cameron, and after being responded to by Lord Goderich, the meeting separated. The annual *soirée* was held on the following evening, and was well and numerously attended. Lord Goderich again presided, and the assembly was addressed by Sir Robert Peel, Major-General Windham, Edward Akroyd, Esq., the Rev. S. Holmes, T. P. Crosland, Esq., Sir William Milner, Bart., H. W. Wickham, Esq., M.P., as well as by most of the speakers of the preceding evening.

To Correspondents.

Mr. Chadwick's reply to Mr. Bridges Adams' paper on "Men and Manufactures" has been received, and publication is deferred for want of space.

MEETINGS FOR THE ENSUING WEEK.

MON. London Inst., 7. Prof. Odling "On Organic Chemistry."
Geographical, 8½. I. Mr. J. S. Wilson, "Extracts from a Journal of the North Australian Expedition." II. Mr. W. K. Loftus, "On the Determination of the River 'Eulæus' of the Greek Historians."
TUES. Syro-Egyptian, 7½. Rev. Dr. Hewlett, "On the Botany of Egypt, as illustrated in the ancient Sculptures and Paintings."
Civil Engineers, 8. Mr. W. Bell, "On the Laws of the Strength of Wrought and Cast Iron."
Med. and Chirurg., 8½.
Zoological, 9.
WED. Literary Fund, 3.
London Inst., 3. Prof. Rymer Jones, "On Vivaria and their Inhabitants."
Royal Soc. Literature, 4½.
Society of Arts, 8. Mr. W. Fothergill Cooke, "On the Utilization of the Sewage of Towns by the Deodorizing Process established at Leicester, and the Economical Application of it to the Metropolis."
Graphic, 8.
Microscopical, 8.
Ethnological, 8½.
Archæological Association, 8½.
THURS. Philosophical Club, 5½.
London Institution, 7. Dr. R. E. Grant, "On the Natural History of Extinct Animals."
Antiquaries, 8.
Royal, 8½.
FRI. Astronomical, 8.
SAT. London Institution, 3. Mr. T. A. Malone, "On Experimental Physics, chiefly in Relation to Chemistry."
Royal Botanic, 3¾.
Medical, 8.

PATENT LAW AMENDMENT ACT.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, November 28th*, 1856.]

Dated 15*th October*, 1856.

2406. George Guillaume, Southampton—An apparatus for obtaining motive power by means of water or other fluid.

Dated 31*st October*, 1856.

2558. Benjamin Goodfellow, Hyde, Cheshire—Certain improvements in the construction of steam-boilers, and in the mode of supporting steam-boilers on their seatings.

Dated 12*th November*, 1856.

2658. John Patterson, Beverley, York—Improvements in apparatus for churning, which apparatus is also applicable to the washing of roots and other substances.
2660. George Islington Bache, Glasgow—Improvements in lamps and apparatus for affording or supplying artificial light.
2662. Joseph Eccles, Blackburn—Improvements in machinery for making bricks, tiles, pipes, and other articles made of plastic materials.
2664. William Henry Balmain, and Thomas Colby, Saint Helen's, Lancashire—Improved means of grinding various substances.
2666. James Apperly, and William Clissold, Dudbridge, Gloucestershire—Improved apparatus for condensing wool, cotton, and other fibrous substances.
2668. Richard Archibald Brooman, 166, Fleet-street—Improvements in the preparation of fibres for spinning, and in machinery employed therein. (A communication.)
2670. Frank James Wilson Peckman, Puckeridge, Herts, and Charles Frederick Pike, Oxford-street—An armed glove or covering for the thumb and fingers.

Dated 13*th November*, 1856.

2672. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in machinery or apparatus for cutting and folding paper. (A communication.)
2674. Charles Wastell Dixey, 3, New Bond-street—Improvements in double opera glasses, and other glasses of a similar nature.
2676. Thomas Stephen Holt, Manchester, and Edward Earnshaw and James Barlow, Rochdale—Improvements in certain parts of steam-engines, steam-boilers, and apparatus connected therewith.
2678. Thomas Earp, Newark-on-Trent—A tap for measuring liquids.
2680. John Kinniburch, Renfrew, N.B.—Improvements in moulding or shaping metals.

Dated 14*th November*, 1856.

2682. Peter Armand le Comte de Fontainemoreau, 39, Rue de l'Echiquier, Paris—An improved method of forming letters and other devices on metallic surfaces. (A communication.)
2683. Joseph Hacking, Bury, Lancashire—Certain improvements in machinery for dressing, polishing, and finishing threads and yarns.
2684. Thomas Beatt Sharp, and Joseph Anthony Collet, Manchester Certain improvements in locomotive steam-engines.
2685. Adolphe Emanuel Huart, Southampton, Surrey—An improved toy for the use of children.
2686. Richard Emery, 6, King-street, St. James's-square—Improvements in springs for carriages and other vehicles.
2687. Richard Emery, 6, King-street, St. James's-square—Improvements in the construction of axles and boxes of carriages for common roads.
2688. John Rock Day, and Thomas Rutter, Birmingham—A new or improved metallic tile for roofing or covering buildings.
2689. Edward Money, 14, St. James's-square—An improved artificial manure.
2690. Jean Baptiste Heu, 15, Rue St. Lazare, Paris—Improvements in preserving animal and vegetable substances suitable for food. (A communication.)

WEEKLY LIST OF PATENTS SEALED.

November 28th.

1283. Fred. Luke Stott, Thomas Belward, and J. Findlow.
1299. Gustavus Gidley and Wm. Christopher.
1301. Bennett Johns Heywood.
1305. Victor Jean Baptiste Mauban.
1330. Edward Hatton.
1331. Duncan Morrison.
1333. Duncan Morrison.
1349. James Somerville.
1380. Armand Eugene Preux.
1386. John Henry Johnson.
1438. Charles Clifford.
1489. Charles Durand Gardissal.
1515. John Henry Johnson.
1550. Joseph Henry Van Hengel.
1658. Jean Louis Lucas and Albert de Briges.
1973. James Wadsworth.
2120. William Henry Forster.
2134. John Talbot Pitman.
2161. Alfred Vincent Newton.
2184. Thomas Callender Hinde.
2223. John Morrison.
2249. Arthur Albright.

December 2nd.

1303. Auguste Cadet.
1314. George Josiah Mackelcan.
1315. Edwin Heywood and Thomas Ogden Dixon.
1334. John Christophers.
1341. Andrew Edmund Brae.
1360. Samuel Dyer.
1377. Carlo Pietroni.
1388. Alfred Vincent Newton.
1425. Henry Holland.
1426. John Sadler, Josiah Green, and Thomas Davis.
1440. Caleb Perry Sharpley.
1475. Isaac Atkin and Marmaduke Miller.
1560. William Hickling Burnett.
1598. Henry Bollmann Condy.
1608. Alfred Vincent Newton.
1680. Charles Barlow.
1837. Thomas Barnabus Daft.
2163. Robert Walker, jun.
2214. John Roberts and James Beech.
2251. John James Russell and Joseph Bennett Howell.
2282. George Tomlinson Bousfield
2382. Timothy Gilbert.

PATENTS ON WHICH THE THIRD YEAR'S STAMP DUTY HAS BEEN PAID.

November 24th.

2758. Georges Ed. Gazagnaire.

November 25th.

2762. Louis Cornides.

November 26th.

2771. John Carter Ramsden.
2778. Auguste Edouard Loradoux Bellford.
2783. Peter Armand le Comte de Fontaine-moreau.
2804. Alexander Brown.

November 27th.

2772. Alexander Macomie.

November 28th.

2788. John Patterson.

November 29th.

2784. Edward Keating Davis.
2798. John Henry Johnson.
2810. Samuel C. Lister.
2820. Squier Chevin.
2851. Joseph Robinson.